HOLDER FOR PRESSURE-BREWING COFFEE DRINK

Field of the Invention

This is a continuation in part application of the Application Serial Number 10/315,972 filed December 09, 2002 and International application number PCT/US03/39030 filed December 8, 2003. The invention relates to a pressure-brewing device for making fresh coffee drinks such as coffee, espresso, tea, cappuccino, latte, hot chocolate and mocha on demand.

Background of the Invention

The taste of pressure-brewed coffee by espresso machines and single serve coffeemakers (e.g. Senseo™ coffeemakers by Philips and One:One™ coffeemakers by Salton) is strongly dependent on the extraction pressure, temperature and time for the coffee grounds as well as the volume of hot water used to extract the grounds.

A perfect extraction of coffee is indicated by a crema layer on the brewed coffee. The crema layer is traditionally obtained with a high-pressure pump espresso machine when the right grind size and right degree of tamping of the coffee are used. To make it easier to achieve such perfect extraction or crema layer, Muttoni in US Pat. No. 4,882,982, Selby in US Pat. No. 5,127,318, Schiettecatte in US Pat. No. 5,150,645 and Custio in EP 0682902B1 taught improved filter holders to increase the back pressure in the holder, therefore reducing the dependence of the crema layer on the grind size and degree of tamping. However, these improved holders cause unacceptable amount of residual water above the coffee grounds, are difficult to clean and vulnerable to clogging, require very high pressure and are complex and expensive to manufacture. The improved holders taught by the applicant in US Pat. No. 5,638,740, Akkerman-Theunisse et al. in US Pat. No. 6,119,582, Brouwer in EP 1092377 and Philips in Senseo® coffeemakers resolved some of these problems by forming a coffee bath in a container and injecting a high-speed jet into the bath. Such improved holders, however, slow down the brewing process due to the time needed to form and drain the bath, require consumers to clean both the container and filter basket, and is still too complex and expensive for a low cost coffeemaker affordable by average consumers. In addition, such improved holders make all coffee drinks with the same thick crema layer, which dissatisfies those people who prefer a cup of plain coffee without a crema layer.

The volume of hot water through the coffee grounds determines the amount of coffee to be brewed and greatly impacts the strength of the coffee. Illy in US Pat. No. 4,353,293 taught the use of

two pumps in an espresso machine, one for delivering a smaller quantity of water and the other a larger quantity of water at a time, to control the volume of hot water through the coffee grounds. D'Alayer de Costemore d'Arc in US Pat. No. 4,468,406 taught a programmed control unit to control the volume of hot water through the grounds. The devices taught by Illy and D'Alayer de Costemore d'Arc are, however, too complex and expensive to be affordable by average consumers.

In automatic drip coffeemakers, which exert no pressure to coffee grounds, the strength of the coffee may be controlled by a by-pass valve assembly as taught by Lassota in US Pat. No. 5,000,082, McDonough in US Pat. No. 4,328,740, Vink in US Pat. No. 4,108,053 and Brown in US Pat. No. 4,056,050. Such by-pass valve assembly uses a valve located in the brew head or water spreader of the coffeemaker to divert a part of the hot water to a special passageway in the coffee basket or filter holder without contacting the coffee grounds. Such prior art valve assembly has several drawbacks that prevent it from broad use. First, such by-pass valve assembly does not work in pressure-brewing machines (e.g. espresso machines) because unlike the automatic drip coffeemaker that delivers hot water at almost constant flow rate, the flow rate delivered by the pump in the pressure-brewing machines may vary several hundred percent depending on the flow resistance caused by the by-pass valve assembly. Such large flow rate variation will cause the prior-art by-pass valve assembly to malfunction, and even cause the mix of hot water and coffee grounds to overflow the rim of the filter basket to the carafe. Second, the by-pass valve assembly is susceptible to misalignment of the valve in the brew head or spreader and the special passageway in the basket when the user places the basket below the brew head. Third, since the by-pass valve assembly is partly in the brew head and partly in the basket, any malfunction of the valve assembly will require the user to replace the whole coffeemaker. Last, such valve assembly does not measurably change the strength of the coffee, especially when a full pot or carafe of coffee is brewed.

It is an object of the invention to provide a pressure-brewing pod holder that allows consumers to brew either one cup or two cups of coffee drinks at the same amount time, therefore providing consistent coffee taste independent of the amount of coffee brewed.

It is an object of the invention to provide a pressure-brewing pod holder that allows consumers to readily adjust the brewing pressure for the coffee grounds.

It is a further object of the invention to provide a pressure-brewing holder that allows consumers to readily and significantly change the strength of the coffee brewed.

It is a still further object of the invention to provide a device for making crema at low pump pressure, thus reducing the cost of the coffee machines.

It is a still further object of the invention to provide a device for making crema that is inexpensive enough to be disposable when it is used as part of a disposable coffee cartridge.

It is a still further object of the invention to provide a coffee basket that enables consumers to change the volume of drink to be brewed without adjusting the brew head or coffeemaker.

It is a still further object of the invention to provide a coffee basket that enables consumers to change the strength of drink to be brewed without adjusting the brew head or coffeemaker.

Still other objects will become apparent after reading the accompanying drawings and description. It should be understood that the invention could still be practiced without performing one or more of the objects set forth above.

Summary of the Invention

Accordingly, the invention provides a holder that brews coffee with a fine golden crema layer and allows consumers to readily adjust the brewing pressure, the volume of coffee and strength of coffee brewed. In a first embodiment of the invention, the holder comprises a bowl-shaped inner space for receiving a coffee pod, a peripheral edge for sealing to the brew head of a coffee machine, a collection chamber for receiving the coffee from the pod, a sufficiently small orifice to cause the drink to exit the collection chamber as a sufficiently high-speed drink jet, a reflector located a predetermined distance below the orifice for implanting air into the drink, an emulsion surface below the reflector for forming an emulsion from the air-implanted drink, and a drink channel for removing the drink from the reflector and emulsion surface and delivering it to a cup. The emulsion surface and drink channel are sufficiently sloped in one direction to render the reflector free of coffee and to save brewing time. The predetermined distance is sufficiently long to prevent sputtered drink droplets from disrupting the jet formation and to enable the jet to travel freely at the sufficiently high speed in a vacuous air space but is sufficiently short to allow the jet to maintain its momentum before reaching the reflector. The holder enables a thick, fine crema layer to form in the cup even if the coffee machine is a low-cost machine that delivered hot water under pressure as low as 1.5 bars. A plurality of air traps may be formed on the reflector for facilitating the implantation of air into the drink when the drink jet reaches the reflector, thus improving the quantity and quality of the crema generated.

The holder may further comprise a crema modulator connected to a cylindrical body below the small orifice to allow consumers to readily turn on or off the crema. The modulator comprises a fluid control member having a sufficiently large opening and a handle for a user to move the fluid control member. The handle may be turned to move the fluid control member between a first position, in which

the orifice and the sufficiently large opening are aligned to allow the drink jet to pass through the opening freely to preserve its sufficiently high-speed for the generation of crema, and a second position, in which the orifice and the sufficiently large opening are mis-aligned to prevent the drink jet from generating crema.

In a second embodiment of the invention, the holder comprises a bowl-shaped inner space for receiving a coffee pod, a peripheral edge for sealing to the brew head of a coffee machine, a collection chamber for receiving the coffee from the pod, and a cup modulator below the collection chamber for a user to select to brew one small, medium or large size cup of coffee in a given period of time (e.g. in 30 or 60 seconds). In a first example, the cup modulator comprises a fluid control member having a small, a medium and a large orifice and being supported on the bottom plate of the collection chamber, a handle having a cylindrical body connected to the fluid control member by a connecting rod, and a loaded spring to ensure a seal between the fluid control member and the bottom plate. To select the cup size to be brewed, the user simply turns the handle to align one of the small, medium and large orifices with a discharging opening on the bottom plate to brew a small, medium or large cup of coffee, respectively. In a second example, the cup modulator comprises a tapered channel on the bottom plate of the collection chamber, a fluid control member having a restriction member dimensioned to fit into the tapered channel to change the flow resistance of the drink through the tapered channel and a large opening for the drink to pass freely, a handle having cylindrical body connected to the fluid control member by a rigid connector, and engagement threads to prevent the drink pressure from dislodging the fluid control member. To brew a large cup of the coffee, one simply turns the handle to move the fluid control member out of the tapered channel. To brew a small cup, one simply turns the handle to move the fluid control member into the tapered channel. In order for the cup modulators to work properly, the pod should be sufficiently large in diameter and the coffee grounds should be sufficiently coarse to make the pressure drop through the pod not significantly higher, preferably smaller, than that through the small or medium orifice or the tapered channel during brewing. The cup modulator works preferably with coffee machines designed to deliver less water in a given duration of time when the pressure drop downstream the pump of the machine is increased.

In a third embodiment of the invention, the holder comprises a bowl-shaped inner space for receiving a coffee pod, a peripheral edge for sealing to the brew head of a coffee machine, a collection chamber for receiving the coffee from the pod, and a Pressure modulator for modifying the brewing pressure for the coffee pod in the holder. The Pressure modulator works preferably with a coffee machine that is designed to deliver an approximately fixed amount of water in a given time period

independent of the pressure drop downstream the pump. The Pressure modulator comprises a hot water channel having a first and second ends located near the seam of the pod and a third end located below the collection chamber, a fluid control member having a mixing channel with a top end open to the collection chamber and a bottom end for discharging the drink, a handle connected to the fluid control member by a rigid rod, and engagement threads for preventing the drink pressure from dislodging the fluid control member. The fluid control member further comprises a first channel that is large to reduce the brewing pressure significantly to cause a weaker cup of coffee, a second channel that is relatively small to reduce the brewing pressure moderately to cause a medium strength coffee, and a third channel that is the smallest to reduce the brewing pressure only slightly to enable a strong cup of coffee. Each of the first, second and third channels has one end connected to the third end of the hot water channel and the other end connected to the mixing channel. The handle comprises a cylindrical body and a rigid connector having one end fixed to the cylindrical body and the other end connected to a knob slidingly received in a horizontal slot on the handle of the holder to facilitate the adjustment of the coffee strength. It was found that when used in coffee machines capable of delivering more water within a given duration of time when the pressure drop downstream the pump is lower, the Pressure modulator could allow the consumers to adjust both the volume and strength of the coffee brewed.

Description of the Drawing

The accompanying drawing illustrates diagramatically non-limitative embodiment of the invention, as follows:

Fig. 1 is a cross-section view of a coffee holder for making coffee;

Fig. 1a is a cross-section view of an improved reflector for the holder of Fig. 1;

Fig. 2 is a cross-section view of a second preferred embodiment of the coffee holder for making coffee;

Fig. 3 is a cross-section view of a third preferred embodiment of the coffee holder for making coffee;

Fig. 4 is a cross-section view of a fourth preferred embodiment of the coffee holder for making coffee;

Fig. 4a is a cross-section view taken along line A-A for the holder of Fig. 4;

Fig. 5 is a cross-section view of a fifth preferred embodiment of the holder for making coffee;

Fig. 6 is a cross-section view of a sixth preferred embodiment of the holder for making coffee;

Fig. 6a is a cross-section view of the fluid control member 203 along the three channels 223a-c;

Fig. 7 is a cross-section view of a seventh preferred embodiment of the holder for making coffee;

Detailed Description of the Preferred Embodiments

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

Fig. 1 shows a first preferred embodiment for brewing under pressure drinks according to the present invention. The device 21 comprises a cylindrical body 23 connected to the bottom 11 of a container or pod holder 10 having a bowl-shaped inner space for receiving a coffee pod or pouch 12 and a peripheral surface 201 for sealing to the brew head of a coffee machine (not shown), a collection chamber 24 for receiving the drink 69 from pod 12 via a plurality of collection channels 15a and 15b on the bottom 11 of holder 10, and a disc 17 connected to collection chamber 24 in a sealed manner and having an orifice 22 for allowing the drink to exit the collection chamber as a drink jet 115 at high speed in a chamber 250. The device further comprises a reflector 29 located a predetermined distance below orifice 22 for receiving the jet and implanting air into the drink to produce air-implanted drink 252, an emulsion surface 251 located below the reflector 29 for forming an emulsion 34 from the air-implanted drink, and a drink channel 30 for delivering or conducting the emulsion 34 to a receptacle such as a cup, in which the emulsion separates to form an appealing crema layer on to top of the drink.

The reflector 29 and the emulsion surface 251 are sloped and positioned above drink channel 30 that is sufficiently sloped. Such a construction causes the emulsion 34 to be delivered or conducted sufficiently quickly away from the reflector and emulsion surface to minimize the amount of drink or emulsion that may be accumulated in device 21 during brewing process, thereby saving the time otherwise required to drain the device and reducing the time needed to brew a cup of coffee. The layer of crema formed on the drink in the cup was very fine and lasted more than six minutes, even when the pressure of the hot water delivered to coffee pod 12 from the coffee machine was as low as 2 bars or kilograms/cm^2. Coffee machines that only need to produce such low water pressure is much cheaper and quieter than their higher-pressure counterparts, thus being highly desirable by consumers. Thick and fine crema was formed by device 21 even when the water pressure from the machine was as low as 1 to 1.5 bars.

During brewing process, it was observed that the reflector was substantially free of the drink or emulsion 34. It is believed that the slope for the reflector 29 provides a downward momentum to the

air-implanted drink 252, which momentum probably helps driving the emulsion 34 quickly away from the reflector to render the reflector substantially free of the drink. It was discovered that when the drink channel 34 was flat or restrictive, drink or emulsion accumulated on reflector 29 during the brewing process and the crema in the cup were coarse and shorter lived. It was also discovered that when the drink channel 34 was small or restrictive enough to cause the drink to accumulate on reflector 29 to such a height that the drink reaches or contacts the orifice 22, no crema was formed on the drink received in the cup. As a result, drink channel 34 should be sufficiently short and large to prevent pressure drop for the drink flow therein and/or be sufficiently sloped for quickly delivering the drink received by the reflector away from reflector.

A plurality of air traps 200 may be formed on the reflector 29 for facilitating the implantation of air into the drink when the drink jet 115 reaches the reflector (Fig. 1a). It was discovered that when the reflector 29 has a smooth surface, significant less amount of crema or even no crema was formed on the drink in the cup. It was also discovered that the amount of crema on the drink could be significantly increased by making the surface of the reflector 29 a roughened surface by either sanding the reflector surface with a sand paper or by the use of a mold with a roughened surface to form the reflector surface. It was also discovered that the amount of crema could be significantly increased by having a protrusion on the reflector to receive the drink jet. The amount and fineness of the crema could be further increased by making the top surface area of the protrusion approximately as small as or smaller than the cross-section area of the drink jet, or by locating the protrusion on the reflector in such a way to cause part of the drink jet not to touch the top surface of the protrusion. It was also discovered that by making the reflector flat or concave, the amount of crema produced is reduced and the crema is significantly coarser and shorter lived, especially when the hot water pressure from the coffee machine is low.

To form crema, it is important that the predetermined distance between reflector 29 and orifice 22 is sufficiently long and the cross-section area of chamber 250 is sufficiently large. It is believed that the sufficiently long predetermined distance prevents the sputtered drink droplets generated on the reflector from disrupting the formation of the drink jet at sufficiently high speed at said orifice, and that the sufficiently large chamber prevents the drink jet from contacting the side wall of the chamber. As a result, the drink jet from the orifice 22 can freely travel at the sufficiently high speed in an empty or vacuous air space above reflector 29 before reaching the reflector, thereby forming the air-implanted drink 252 on the reflector and emulsion 34 in drink channel 30. It was, however, discovered that when the predetermined distance is too long, little or no crema was formed. The proper length for the

predetermined distance is approximately 0.07 to 1.5 inches, preferably 0.1 to 1 inches, depending on the slope and surface morphology of the reflector 29 and the pressure of the hot water provided by the coffee machine.

The orifice 22 should be sufficiently small to produce the drink jet at the sufficiently high speed to generate the emulsion 34 and crema. It was found that when the pump pressure of the coffee machine was less than 3 bars and the coffee volume flow rate was about 4 to 7 ml per second, the orifice should be smaller than 0.03 inches in diameter, preferably smaller than 0.027 inches, in order to achieve fine and long-lasting crema on the drink. It is also appreciated that a vent opening (not shown) may be formed on the side wall of the chamber 250 to facilitate the generation of the emulsion 34 and to facilitate the draining of the liquid in the drink channel 30. It is appreciated that by making the orifice 22 large enough, the device 10 may be used to brew coffee and tea without a crema layer.

The flavor-containing materials enclosed in the pod 12 manufactured from paper filter or other water permeable film may be coffee grounds, milk solids, non-diary creamer, diary creamer, cocoa or any combination of them. In this and other preferred embodiments of the invention, the coffee pod 12 can be replaced by a filter basket, by a permanent filter attached to container 10 above the collection channels 15a and 15b, or by a disposable filter for receiving loose coffee grounds. The coffee pod 12 can also be replaced by a latte pod, a mocha pod, an espresso pod, a hot chocolate pod or other beverage pod that contains appropriate flavor-containing materials for the drink. For the sake of simplicity, in both the description section and the claims section of the disclosure the term drink, coffee or coffee drink will be used to represent any drink such as coffee, espresso, mocha, cappuccino, latte, hot chocolate or hot apple cider that can be made by interacting hot water with flavor-containing solids. Also, the term pod or coffee pod will be used to represent any beverage cartridge or pod throughout this disclosure.

In Fig. 2, the pod holder 10 is received in the chamber 250 of the device 21. Here the reflector 29 and emulsion surface 251 are formed on the inner surface of the bottom 63 of the chamber 250. The bottom 63 is sufficiently sloped to provide sufficient momentum to the air-implanted drink 252 to help driving the emulsion 34 or drink away quickly via the drink channel 30, thereby causing the reflector 29 below the orifice 22 to be substantially free of the drink or emulsion. A crema refiner 100 is removably connected to drink channel 30 via a mouth 101, and it comprises a sloped extension channel 102 and a spout channel 109. The spout channel is sufficiently tilted to produce an emulsion stream 116 that is sufficiently tilted to point to and be received by the side wall 117 of the cup 27. It was discovered that such a tilted emulsion stream significantly improves the fineness of the crema 25 formed on the drink

109 and prevents the formation of coarse air bubbles. It is appreciated that the crema refiner 100 is optional and may be removed from the device 21 without impacting the generation of the crema.

Fig. 3 shows a crema modulator 16 connected to body 23 of the pod holder 10 below the orifice 22 via engagement threads 220 to give consumers a choice to make drink with or without a crema layer. This is an improved version of the crema modulator disclosed in the parent application serial number 10/315,972. The modulator comprises a fluid control member 203 having an opening 209 that is sufficiently larger than orifice 22 to allow the drink jet to pass through substantially freely when orifice 22 and opening 209 are aligned, and a handle 212 for a user to move the fluid control member 203. The user may hold the handle 212 to turn the fluid control member 203 between a first position, in which the orifice and opening are sufficiently aligned to allow the drink jet to pass through the opening freely to preserve its sufficiently high speed for the generation of crema, and a second position, in which the orifice and opening are sufficiently mis-aligned to prevent the drink jet from generating crema. To further prevent crema formation when the fluid control member is in its second position, the space 104 between disc 17 and fluid control member 203 may be made thin enough to prevent the presence of air layer adjacent to the orifice 22 and/or the opening 209 may be made relatively restrictive to cause the drink from the orifice 22 to form a slow drink stream.

The modulator makes it possible to make different coffee drinks such as latte, cappuccino, mocha and coffee with the same container 10. To make traditional cappuccino that has lots of crema on the drink top, the user places the fluid control member in the position shown in Fig. 3. To make traditional coffee that has no crema layer, the user simply turns the handle about ¼ to ½ turns so that the opening 209 of the fluid control member is mis-aligned with the orifice 22. It is appreciated that the crema modulator 16 also works for the device taught by the applicant in US Pat. No. 5,638,740 and for the Senseo® coffee maker by Philips and Sara Lee.

Fig. 4 shows a cup modulator 207 connected to the body 23 of the pod holder 10 for a user to select whether to brew one small, medium or large size cup of coffee within a given period of time. The cup modulator comprises a fluid control member 203 supported by the bottom 237 of the collection chamber 24, a handle 212 having a cylindrical body 214 and a drink outlet 209, a rigid connector 216 to connect and fix the body 214 to the fluid control member, and a spring 205 for applying a predetermined force to the fluid control member to ensure that the lower surface of the fluid control member is sealed to the upper surface of the bottom 237. A small orifice 217, medium orifice 219 and large orifice 204 (Fig. 4a) are formed on the fluid control member. An discharging opening 232, which

is preferably larger than the large opening 204, is formed on the bottom 237 and is aligned with the drink outlet 209.

To select the volume of coffee to be brewed within a given duration of time set by the coffee or beverage machine, the user simply turn the handle 212 below the pod holder 10 to align one of the small orifice 217, medium orifice 209 and large orifice 204 on the fluid control member with the discharging opening 232 to brew a small, medium or large cup of coffee, respectively. In one particular example, the small orifice 217, medium orifice 219 and large orifice 204 have diameters of 0.60 mm, 0.80 mm and 1.5 mm, respectively, and the coffee machine is a Senseo® machine from Philips. When the brewing time is set at about 40 seconds, about 140 ml of coffee is brewed when the small orifice 217 is aligned with the discharging opening 232, 180 ml is brewed when the medium orifice is aligned with the discharging opening, and 280 ml is brewed when the large orifice is aligned with the discharging opening.

The duration of time may be as short as 15 seconds if the pod 12 contains very fine coffee grounds and the coffee machine has a pump that can deliver hot water at higher pressure, or may be as long as two minutes if the pod 12 contains relatively coarse coffee grounds and machine has a pump that can deliver hot water at relatively low pressure. The duration of brewing time may be controlled by an electronic or mechanical timer in the machine that turns off the hot water or the pump at the end of the duration.

It is appreciated that the bottom 237 may comprise a smooth ceramic or metal upper surface and the fluid control member may comprise a smooth ceramic or metal lower surface to ensure a reliable and consistent seal between the upper surface and lower surface, thereby ensuring all the drink that reaches the discharging opening 232 is from only one of the small, medium and large orifices 217, 219 and 204. It is also appreciated that the pump of the coffee machine is preferably constructed to deliver high water flow rate at low water pressure and at significantly lower water flow rate as the pressure increases.

It is also appreciated that, in order for the modulator 207 to work well in adjusting the volume of coffee brewed in a given duration of time, the flavor-containing materials in the pod 12 should be so packed or ground that the flow resistance or pressure drop of the hot water through the pod is not significantly higher than that through the small orifice 217 and medium orifice 219. Preferably, the flow resistance or pressure drop through the pod 12 is smaller than that through the medium orifice 219. To achieve the lower flow resistance through the pod, the pod may be made to have a diameter larger than about 2.2 inches and thinner than 0.3 inches. It is also appreciated that the small orifice 217,

medium orifice 219 and large orifice 204 may be formed on the bottom 237 and the fluid control member 203 is shaped to allow the user to turn the handle 212 to selectively cause the member 203 to close one or two of the small, medium and large orifices either partially or completely.

Fig. 5 shows an alternative cup modulator 207 that comprises a tapered channel or opening 232 on the bottom plate 237 of the collection chamber 24, a fluid control member 203 having a restriction member 235 dimensioned and tapered to fit into the tapered channel 232 to change the flow resistance of the drink through the tapered channel and a large opening 211 for the drink to pass through the fluid control member freely, a handle 212 having cylindrical body 214 and drink outlet 209, a rigid connector 216 for connecting the handle to the fluid control member, and engagement threads 235 located on the upper part of the body 23 and on the fluid control member to prevent the pressure of the drink from pushing the fluid control member out of the body 23. To brew a large cup of the coffee within a given duration of time (e.g. within 45 seconds) during which hot water is delivered under pressure through the pod 12, one simply turns the handle 212 to move the fluid control member downwards. To brew a small cup of coffee within the same given duration of time, one simply turns the handle 212 to move the fluid control member upwards.

The advantage of the cup modulator 207 of Fig. 5 over that of Fig. 4 is that the modulator may be removed from the pod holder 10 by simply turning the handle 212 to un-thread the fluid control member from the body 23, thus facilitating the cleaning of the modulator. It is appreciated that a restrictive flow channel may be formed on the bottom 237 or on the restriction member 235 to allow a minimum coffee flow rate when the fluid control member 203 is turned to its uppermost position. It is also appreciated that, in order for the modulator 207 to work well in adjusting the volume of coffee brewed in a given duration of time, the flavor-containing materials in the pod 12 should be so packed or ground that the flow resistance or pressure drop of the hot water through the pod is not significantly higher, preferably lower, than that through the tapered channel 232 with the restriction member 235 in it.

In Fig. 6, a Pressure modulator 207 is presented for modifying the brewing pressure for the coffee grounds enclosed in pod 12 received in holder 10. As in the exemplar embodiments of Figs. 1-5, during the brewing process a watertight seal is formed between the peripheral edge 201 of the holder and a seal member on the brew head of the coffee machine. The Pressure modulator comprises a hot water channel 229 having a first end 227 located near the peripheral seam of the pod 12, a second end 228 located below but adjacent to the seam of the pod and a third end 230 located adjacent to collection chamber 24, a fluid control member 203, an improved handle 212, a rigid connector 216 for connecting

the handle to the fluid control member, and engagement threads 220 located on the upper part of body 23 and on the lower end of the fluid control member to prevent the pressure of the drink from pushing the fluid control member out of the body 23. Unlike the cup modulators of Figs. 4 and 5 that preferably work with a coffee machine designed to deliver less water within a given duration of time when the pressure drop downstream the pump of the machine is increased, the Pressure modulator preferably works with a coffee machine that is designed to deliver a fixed or approximately fixed amount of water in a given time period substantially independent of the pressure drop downstream the pump.

The fluid control member 203 is cylindrical and has a tapered mixing channel 222 with a top end open to the collection chamber and a bottom end for discharging the mixed coffee/hot water to the drink outlet 209. The fluid control member further comprises a first channel 223a that is less restrictive to water flow for a weaker cup of coffee, a second channel 223b that is fairly restrictive to water flow for a medium strength coffee, and a third channel 223c that is most restrictive to hot water flow for a strong cup of coffee (Fig. 6a). Each of the first, second and third channels has one end connected to the third end 230 of the hot water channel for receiving hot water and the other end connected to the mixing channel 222 for introducing the hot water from the hot water channel 229 to the mixing channel. The top part of the fluid control member is dimensioned to fit slidingly into the cylindrical collection chamber 24 in such a way to prevent the hot water from channel 229 from entering the collection chamber and to ensure that all or most of the hot water from the channel 229 enters the mixing channel 222 via only one of the channels 223a-c. The diameter for the channels 223a, 223b and 223c may be in the range of about 0.2 to 2 mm. It was found that if the channels 223a-c and the hot water channel 229 are too large, for example if each of them has a diameter of 3 mm or larger, the coffee brewed was watery and not acceptable. It was also found that when finer coffee grounds is used in the pod 12, the channels 223a, 223b and 223c generally have to have a smaller diameter to effectively adjust the strength of the brewed coffee.

It was also found that when one of the channels 223a-c was connected to third end 230 of the hot water channel 229, the brewing pressure in the pod holder 10 became significantly lower than when none of the channels was connected to the hot water channel 229. It was also found that the brewing pressure increased when one turned the knob 241 to move the fluid control member 203 from a first position in which the channel 223a is aligned with the third end 230 to a second position which the channel 223b is aligned with the third end 230 of the hot water channel. It was also found that if the third channel 223c was made very small in diameter or removed, the brewing pressure was the highest

and coffee brewed is the strongest. It is believed that the change of the coffee strength by the Pressure modulator 207 is likely due to the change in brewing pressure when different one of the channels 223a, 223b and 223c is aligned with the third end 230.

The improved handle 212 further comprises a rigid connector 240 having one end fixed to the cylindrical body 214 and the other end connected to a knob 241 slidingly received in a horizontal slot 242 on the handle 245 of the pod holder 10 besides the cylindrical body 214 and drink outlet 209. Such an improved handle enables a user to adjust the coffee strength after the pod holder 10 has been mounted to the coffee machine or even after the machine has started the brewing process. It is appreciated this improved handle may be used for the cup modulators shown in Figs. 4 to 5 for changing the amount of the coffee to be brewed and for the modulators in Fig. 3 and the parent Application Number 10/315,972 for switching off the crema.

It was found that when the Pressure modulator 207 is used in coffee machines that are capable of delivering more water within a given duration of time when the pressure drop downstream the pump is decreased, the Pressure modulator may help adjusting both the volume and strength of the brewed coffee. A significantly larger but weaker cup of coffee was brewed when the channel 223a was connected to the third end 230 of the hot water channel 229 than when the channel 223c was connected to the third end 230. The coffee brewed when the channel 223a was connected to the third end 230 was significantly weaker than the coffee brewed when the channel 223c was connected to the third end 230 of the hot water channel 229 even if the weight ratio of the coffee grounds to the delivered water was made the same.

It is appreciated that mechanism of the cup modulator 207 of Fig. 4 or 5 may be combined into the Pressure modulator 207 of Fig. 6 to allow the consumers to adjust both the coffee strength and amount of coffee (i.e. cup size) to be brewed in a given duration of time (e.g. 40 or 60 seconds). In one particular example, the cup modulator of Fig. 6 may be adapted to allow the restriction member 235 to move into the tapered mixing channel 222 of the Pressure modulator of Fig. 6 to reduce the amount of coffee to be brewed with in a given duration of brewing time, and to out of the tapered mixing channel to increase the amount of coffee to be brewed with in the given duration of brewing time.

It is also appreciated that the mechanism for the crema modulator of Fig. 3 or that described in the parent Application Number 10/315,972 may be combined into the Pressure modulator of Fig.6. In a particular example shown in Fig. 7, a crema switch ring 203a is located between the fluid control member 203 and the handle 212 of the Pressure modulator 207. A small orifice 22a is formed at lower end of the mixing channel 222 to form a coffee jet having a sufficiently high speed to produce crema.

The upper part of the Pressure modulator 207 and the pod holder 10 is the same as that shown in Fig. 6, and are thus not shown in Fig. 7. The crema switch ring has a central opening 270 to receive the connector 216 of the Pressure modulator and a through opening 209a that can be aligned with the small orifice 22a to allow the coffee jet to pass through freely, thus allowing crema to be formed, or be turned away from the orifice 22a, thus preventing crema from being formed, by a handle 212a. The handle 212a is connected to the ring 203a and received by a slot 271 on the handle 212. (The crema switch ring here functions like the fluid control member 203 of the crema modulator of Fig. 3.) It is further appreciated that the mechanism of crema modulator 207 of Fig. 3 or that described in the parent Application Number 10/315,972 may be combined into the cup modulators of Figs. 4 or 5.

The scope of the invention is obviously not restricted to the various preferred embodiments described by way of examples and depicted in the drawings, there being numerous changes, modifications, combinations, additions, and applications thereof imaginable within the purview of the claims.